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Innovative Behavior in European Cities

The Relevance of Knowledge Networks

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This study is concerned with spatial innovative behavior of firms in European cities in three countries: Italy, the Netherlands, and the United Kingdom. Three elements play essentially a central role in the analysis: (1) the company and its innovative behavior, (2) the local production environment, and (3) knowledge networks. Uncertainty and uncertainty reduction appear to have a strong influence on the interplay between these elements, in such a way that different innovative strategies may arise, for example, product and process innovation. In the article a comprehensive score that represents the significance of the local production environment for both product and process innovation will be proposed and explored for various cities in the countries concerned. In a comparison between the manufacturing and the service sector in the Netherlands, the local production environment appeared to have more influence on product innovation that on process innovation. Besides, the manufacturing sector appeared to perceive its environment as being relatively less important, whereas the service sector clearly has a different view. Because of the need for uncertainty reduction, local (knowledge) networks—in particular, links with local universities and colleges—turn out to be increasingly important. From our empirical results, we conclude that companies that maintain strong knowledge relationships tend to value their local environment higher than companies without such links.

INTRODUCTION

Cities are one of the earliest and most productive inventions of mankind. In the course of history different socioeconomic phenomena can be observed in cities that exhibit a wide spectrum of evolutionary patterns. Because of the often dominant influence of one

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specific key force on urban development in a given era, different historical periods tend to show a diversity of characteristic cities (Mokyr, 1995). For example, in the Roman Period, cities acted preponderantly as a source of information exchange: people came to the arena to meet one another. In the Middle Ages, the city acted as a safe home port against various enemies, such as people from other cities, barbarians, or illness and poverty. During the Industrial Revolution, cities functioned as a source of employment in large-scale production. In brief, the city has passed through many stages during the socioeconomic history of our world (Grübler, 1994).

It is a remarkable fact that cities have always existed and flourished in a competitive sphere. For example, the crusades did not only cause political-religious shifts, but also exerted significant socioeconomic effects on the European cities of the early 1100s. Other historical examples concern the Hanseatic cities and the increasing wealth in various European cities that resulted from the flourishing cotton industry. Last but not least, in the northwestern European context, we may refer to the eternal competition between Amsterdam and Antwerp (Van der Wee and Aerts, 1989), where geographical factors instigated fierce competition: Amsterdam has a harbor located at the IJsselmeer (former Southern Sea) and the connecting North Sea Channel, and Antwerp is located along the Schelde, an important open sea infrastructure which discharges into the North Sea. Clearly, nowadays the competition for world's largest harbor has shifted from being between Antwerp and Amsterdam to being between Rotterdam and Antwerp. In the light of urban dynamics, in both economic history and urban sciences a variety of economic approaches to investigating interurban competition has been developed over the past decades (Pompili, 1990; Cheshire and Gordon, 1995).

In recent years, various influences on urban evolution can be distinguished (Lambooy, 1988). In the early 1970s, an economic recession mainly caused by the oil crisis largely dominated the economy, and hence also the process of urban growth. Several years later, another oil crisis exerted again a major influence on the economic situation of many regions and cities. As a consequence, a rapid rise in unemployment took place all over the world. In the early 1980s, unemployment was the most important problem politicians were concerned about. A change in corporate strategy, particularly including technological innovation, was clearly necessary in order to survive in an increasingly competitive world. A spatial and economic restructuring strategy based upon the dynamic entrepreneurial views of Schumpeter (which had been introduced several years previous) became common practice (Schumpeter, 1934). The Schumpeterian idea means a survival strategy of firms with regard to price competition for existing products and product competition for new niches (Geenhuizen et al., 1992). Innovative behavior plays a central role in the strategy. By following the strategy, companies may achieve a competitive advantage in the consumer market (Ansoff, 1986/1987; Johnson and Scholes, 1988). Within this framework, increasing attention has been paid to the spatial distribution of innovative firms and the (spatial) conditions that favor innovativeness of cities (see Davelaar, 1989; Cappellin and Nijkamp, 1990; Kleinknecht and Poot, 1990).

Innovativeness and competitive power of cities depend largely on three success conditions: (a) an appropriate management of the limited urban carrying capacity (in terms of scarce space, resources, and environment), (b) the advancement of multifunctionality (favoring economic diversity and stability of urbane evolution), and (c) an improvement of interaction and communication networks with respect to other cities.

The development of urban economic life is strongly dependent on the business sector (Forrester, 1969). In a competitive urban milieu, companies have to focus more on communication networks that have an action radius that encompasses more than just

their own region (Camagni, 1991). By means of intensive spatial interaction and communication, companies—and, on a higher scale, cities—are linked to other regions of our world. The connected regions are more able to benefit from one another than stand-alone regions. This is a clear case of spatial externalities. An important strategic element would be to make the urban territory multifunctional, so that various activities—through urbanization economies—may benefit from each other and may particularly form a solid cradle for innovation (Ewers and Nijkamp, 1990).

In light of the geography, culture, economic conditions, and entrepreneurial attitudes in different cities, it is clear that the intensity and impact of innovation differ from one region to another (see also Mouwen and Nijkamp, 1992). Recently, Geenhuizen and Nijkamp stated: "Patterns of innovation exhibit a clear geographic component, not only because of sectoral variation among firms in different areas, but also because of differences in locational requirements and in spatially discriminating urban and regional policies" (Geenhuizen and Nijkamp, 1993). In this vein, this article will focus on the way innovative firms evaluate and employ their production location as a source of entrepreneurial opportunities.

The continuing competition and permanent restructuring of the business sector in the last 20 years clearly justify an in-depth investigation of the innovative behavior of companies and how such behavior mirrors a geographical pattern. Three elements play an essential role in the present innovation study, namely, entrepreneurial innovation, the firm's environment, and (knowledge) networks (see Figure 1).

Because companies are a major source of innovations, the unit of analysis in our study will be the company. Innovations can be developed inside the company itself or with the help of external organizations connected with the company (Shetty and Buehler, 1987). Both companies and external organizations are assets of a region (Grabher, 1993). They both influence and are influenced by their local environment (Porter, 1990). Therefore, the second element is the local environment of a company. In order for a company to be innovative, its environment must provide various advantages, such as nearby suppliers and customers, a high-quality labor market, and conducive (local) government policy.

This article will particularly focus on knowledge networks, the third relevant element in Figure 1 (Håkansson, 1987; Batten et al., 1989; Kamann and Strijker, 1991). By means

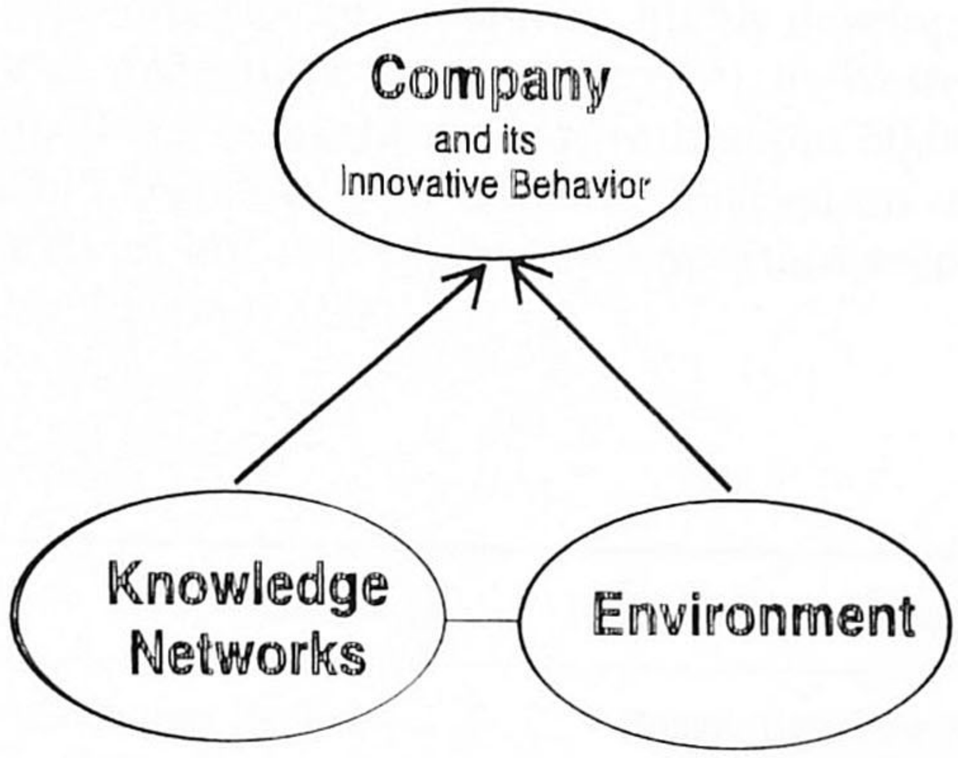

Figure 1 Relevant elements and relationships in the study.

of such networks information and knowledge is collected, and may be used for developing new ideas and innovations (Ouwersloot, 1994). In particular, knowledge networks are necessary for reducing the uncertainty involved in technology design and market strategy (Geenhuizen and Nijkamp, 1995).

It has been indicated above that companies need various facilities for initiating and continuing their (innovative) activities. These facilities can be offered by the local environment. When these facilities are absent or of poor quality, the success of a company may be low and innovation may be hampered. In this context, our study is concerned with the following research question: *What is the importance of the local production environment for innovative companies and how can differences in perceived importance be explained?*

To obtain insight into relevant background factors of the above-mentioned importance of the production environment, two sets of behavioral characteristics of the company will be investigated: type of innovation and use of knowledge networks. The analysis will be based on individual firm data in various European countries. Because knowledge networks play an essential role in innovation (Pred, 1977), particular attention will be paid to the role of one important kind of knowledge networks, namely, that between companies and local universities and colleges.

BACKGROUND DATA

The relevant data from our study originate from diverse cities in different countries. One condition for the selection of cities was that the investigated cities host a university, a higher educational institute, or a technical institute with specific expertise (Townroe, 1991). This choice is made in the context of a knowledge network as a feedback for innovative behavior. In the framework of this study, various cities in Italy, the Netherlands, and the United Kingdom were selected (Table 1). We will now discuss reasons for our selections.

The reasons for selecting the Italian cities are as follows (see also Figure 3). Milano is the city with the most modern industry in Italy. Compared to other Italian cities, it has a leading role in the national industrial sector and also in the service sector, particularly as a headquarter center. Milano has over 2 million inhabitants and is an important European business center. The city has the power to be competitive with respect to other European cities. Milano is one of the cities which form the southern part of the European Banana (Masser et al., 1990). This Banana contains a highly developed area, which is formed by the main ports (and main ports in development) in Western Europe. In contrast to Milano, Como is a small city in northern Italy with about 50,000 inhabitants. The industry in Como is rather old-fashioned and is mainly focused on silk production. The city is not dependent on Milano, but Como plays an important second fiddle with regard to Milano (Capello, 1994; Eurostat, 1993).

TABLE 1 • Investigated Cities

Italy	*The Netherlands*	*United Kingdom*
Como and Milano	Eindhoven Region, Rijnmond, Amsterdam, and The Hague	Bristol, Coventry, Newcastle, Sheffield, Nottingham, Reading, Blackburn, and Peterborough

The Dutch cities in our sample have different characteristics (Davelaar and Nijkamp, 1991). The Netherlands can be subdivided into three parts, namely, the Core, the Intermediate Zone, and the Outer Zone (Figure 2). The investigated cities (or urban areas) belong to two different zones. Amsterdam, Rijnmond, and The Hague are in the Core and the Eindhoven Region is in the Intermediate Zone.

Rijnmond together with Amsterdam can be regarded as a rather dominant agglomeration in the Netherlands. It fulfills the role of a main port in Europe. Rijnmond can be characterized as an urban area with a large share of industry in the field of mass goods, as a result of the big seaport of Rotterdam. Amsterdam (and its airport Schiphol) focuses its industry on higher-value and semimass goods (de Wit and van Gent, 1986). Amsterdam and The Hague host mainly service firms. Although Amsterdam is the capital of the Netherlands, The Hague can be considered as the administrative government center of the Netherlands. The Eindhoven Region, on the other hand, is a smaller urban area. In this area many Dutch international companies are located, for example, Philips, Volvo Ned Car and DAF Trucks. In terms of knowledge networks, the area is dominated by the presence of a university of technology. Furthermore, the Eindhoven Region is close to the frontier with Belgium and Germany. The Eindhoven Region is dominated by the electrotechnical industry (Eurostat, 1992). It should be added that the Netherlands are located in the upper part of the European Banana (Budil-Nadvornikova and Kleinknecht, 1993).

The selected English cities (see Figure 3) were chosen from the full list of those cities selected by the Urban Programme assistance from the U.K. government, to reflect both a geographical spread and a range of types of urban economies with varying degrees of contrast in structure, performance, and local experience of relevant policy measures (Hall et al., 1987). The selected British cities are partially outside the European Banana.

The above selected cities, their structures, and their locations clearly underline the aim of our analysis, namely, to fully explore differences in appreciation of the local environment by innovative firms (Mills and Hamilton, 1989; Armstrong and Taylor, 1993).

Our study is based on companies originating from the manufacturing sector and the service sector. Our investigation into the manufacturing sector is organized internationally, so that cross-national comparative research among the three countries at

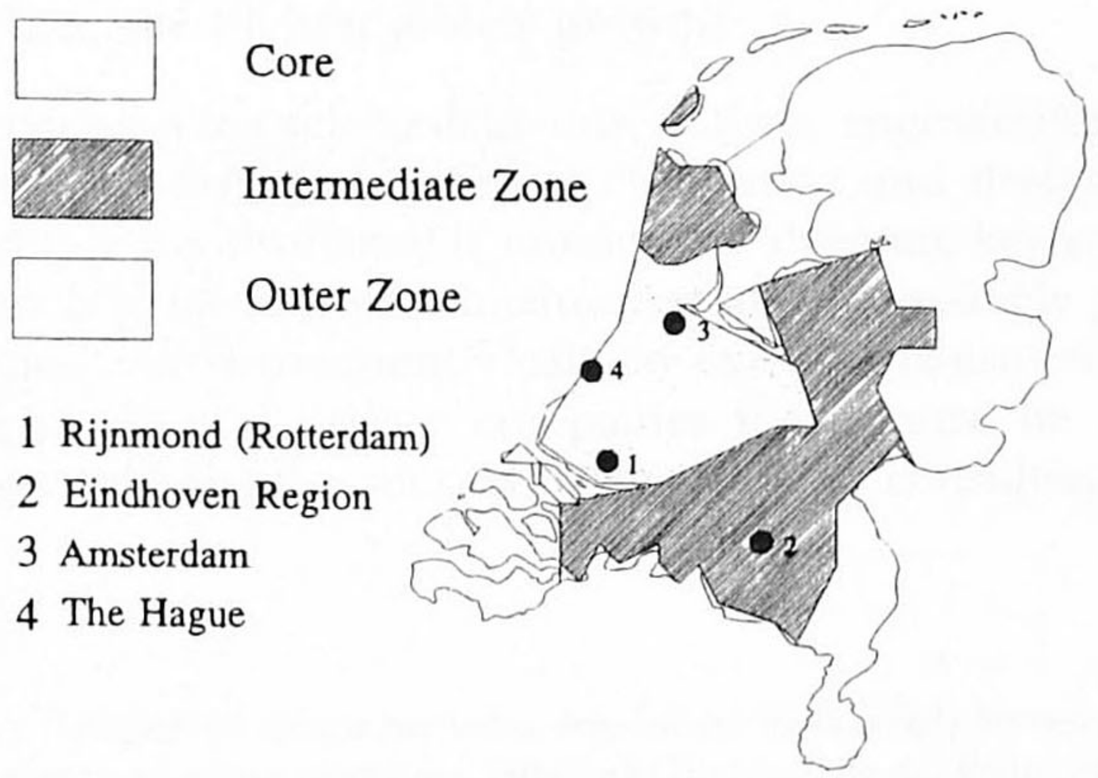

Figure 2 The Netherlands and its tripartition.

Figure 3 Selected cities in Italy and the United Kingdom.

hand is possible. Because of data limitations, the investigation into the service sector is unfortunately restricted to only one country, namely, the Netherlands (Table 2). The total number of investigated firms (273) differs per country as follows: Italy (32), the Netherlands (33), and the United Kingdom (208). In order to guarantee a cross-national comparison of results on an individual firm basis, an identical questionnaire designed by the so-called URBINNO group[1] was used in each of the three different countries (see, for details, Damman, 1994). The standardized questionnaire used here is based on both a retrospective (the past) and a prospective view (the future) (Nijkamp et al., 1991).

The manufacturing firms interviewed in the participating cities were selected on a common basis. They were drawn either from the machinery sector or from sectors that could be regarded as important for the city concerned by using employment and value-added statistics on a two-digit ISIC classification (Damman, 1994):

- the largest sector in terms of employment.
- the sector with the highest growth rate in employment.
- the sector with the highest output growth commensurate with a nonzero growth in employment (i.e., the highest jobless growth).

The specific service sector selected in this study is engineering consultancy. Engineering refers here to all kinds of technical equipment and design. A reason for this choice is that engineering consultancy is nowadays a dynamic key sector, in particularly because governments and other public institutions are increasingly privatizing or sourcing out their activities and consequently call on external consultancy (Nijkamp et al., 1990). Besides, the trend that private companies focus more on their core business is another factor that explains the success of engineering consultancies in private companies.

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[1]The URBINNO network (URBINNO stands for *urban innovation*) links nearly 50 research workers with a clear interest in urban phenomena and urban problems. Originally financed by the Volkswagen Foundation (between 1987 and 1989), the network operated as four working groups, all concerned with aspects of innovation in cities, namely, population, the urban economy, institutions and infrastructure, and the urban firm. The authors wish to thank particularly Tomaso Pompili and Peter Townroe, who made the Italian and British data available.

TABLE 2 • Investigated Cities and Sectors

Sector	*Italy*	*The Netherlands*	*United Kingdom*
Manufacturing	Como and Milano	Eindhoven Region, Rijnmond	Bristol, Coventry, Newcastle, Sheffield, Nottingham, Reading, Blackburn, and Peterborough
Service		Eindhoven Region, Rijnmond, Amsterdam, and The Hague	

HOW COMPANIES JUDGE THEIR LOCAL ENVIRONMENT

An important strategic question concerns the significance of local factors for the success of the company in business, both in the recent past and as foreseen in the mid-1990s. The attributes of the local city region distinguished in our study range from the situation in the labor market to the quality of local infrastructure, which contains aspects like transport facilities, telecommunications services, and business services supporting technology, marketing, and management (Nijkamp et al., 1994). In addition, the attributes concern the presence of local customers, universities, and financial institutions. Various commercial institutions and services are also part of the city attributes, such as Chambers of Commerce and Industry, trade associations, business clubs and societies, and conference services (Beije, 1989).[2]

In order to obtain an overall impression of the general relevance of the local environment, we calculated a comprehensive score per company by dividing the frequency of the answers "some importance" and "major importance" (see footnote 2) by the maximum total answers possible for one company (24). In doing so, the weight for the answers "major importance" is valued twice as high as the weight for the answers "some importance," and the weight for the answers "no importance" or "no answer" is equal to zero. The unit of measurement of this score is a ratio standardized as a comparative index. This local environment score (LES) has thus been calculated as follows:

$$\text{LES} = \frac{\alpha * X_1 + \beta * X_2}{\Sigma} * 100,$$

where α = "major importance"(2), β = "some importance" (1), X_i = the frequency of the answers (i = 1,2; 1 = "major importance;" 2 = "some importance"), and Σ = the total number of possible attributes (24). A score of 200 means that all city attributes have a major importance for the company; a (minimum) score of 0 means that the city attributes

[2]The standardized answers to be given regarding these attributes are: 0 = no answer, 1 = no importance, 2 = some importance, and 3 = major importance. Next, a simple approach has been developed in order to compose a comprehensive score that identifies the *general* significance of the local environment of companies in the various European cities. In this approach, it is taken for granted that—although four different answers are relevant for our data processing—only two answers have an interesting value to be included into the comprehensive score, namely, the answers "some importance" and "major importance."

have neither some nor a major importance for the company. Because the city attributes are widely divergent in nature, they give a comprehensive impression of the relevance of the business environment of a company.

The frequency distribution of the scores of the interviewed firms in all cities investigated can be found in Table 3, subdivided into three classes: low, medium, and high frequencies. For example, the medium category contains score values between 51 and 75. Regarding the past, the share of the medium LES category is thus 34% of the total sample, and the share of the high LES category is 38%. This means that there are almost three times as many firms that attach a medium or high importance to their local environment than firms that attach only a low importance.

Thus, the importance of local factors for the success of business firms in the recent past is clearly confirmed by our general comprehensive LES scores. In addition, companies in European cities tend to value their local environment even higher in the future than in the past. Although the share of medium scores is slightly lower (31% versus 34%), it is evident that the share of high scores is considerably higher (47% versus 38%). We will offer a more detailed view on the high importance of the local environment in the next section, which will focus on Dutch firms.

THE IMPORTANCE OF THE LOCAL ENVIRONMENT IN SELECTED SECTORS IN DUTCH CITIES

Now that we have given a cross-sectional overview of the results for several European cities, we will focus our attention in greater detail on Dutch cities. A comprehensive score with regard to both product innovation and process innovation will be given for both the manufacturing and the service sector in Dutch cities. This score will be determined in the same way as the general score discussed in the preceding section.

Product and process innovations play an essential role in the theory of the product life cycle (see Kleinknecht and Reijnen, 1991). Product innovation—new or improved products and services that influence economic competition and dynamics—concerns the introduction of new products in a market that is surrounded by uncertainty. Process innovation, on the other hand, is more internal to the firm and influences the duration of the product on the market, taking for granted that the market is already acquainted with this product. Besides, the company may be assumed to know how the market reacts to the product concerned. These two factors reduce the uncertainty regarding the product's potential and hence the uncertainty for the company.

TABLE 3 • Comprehensive Score in European Cities (Three Categories)

LES Score	*LES Range*	*Frequency Past (Absolute)*	*Frequency Past (%)*	*Frequency Future (Absolute)*	*Frequency Future (%)*
Low (L)	0–50	78	29%	60	22%
Medium (M)	51–75	92	34%	84	31%
High (H)	76–200	103	38%	129	47%
Total		273	100%	273	100%

Product Innovation

One of the main activities of the service companies investigated in our sample is to gain the trust of (new) customers by delivering proper advice or consultancy to them. Consultancy concerns, among other things, advising on the introduction of new projects or products into the manufacturing companies that are the customers of these service companies. In terms of Schumpeter, consultancy can be seen as an exogenous science and invention phase (Davelaar, 1989).

New products can be subdivided into two groups. First, there are products that are developed for the first time in the economy concerned, the so-called *general product innovation.* Second, we may distinguish products developed for the first time in a specific company. In this case, the products may be interpreted as a specific kind of product innovation: a more or less existing product is combined with specific requirements of the customer. Both groups of products can be found in the introduction phase of the product life cycle (Rothwell and Zegveld, 1985).

In Figure 4, the frequency of the score value, that is, the degree of importance of the city attributes, for both the manufacturing and the service sector, is given with regard to product innovation. The city attributes of about 34% of the service companies appear to be unimportant. For the manufacturing companies this figure amounts to 18%. The highest score value is found in the service sector, viz. 113. This score is indicated by 5% of the service companies.

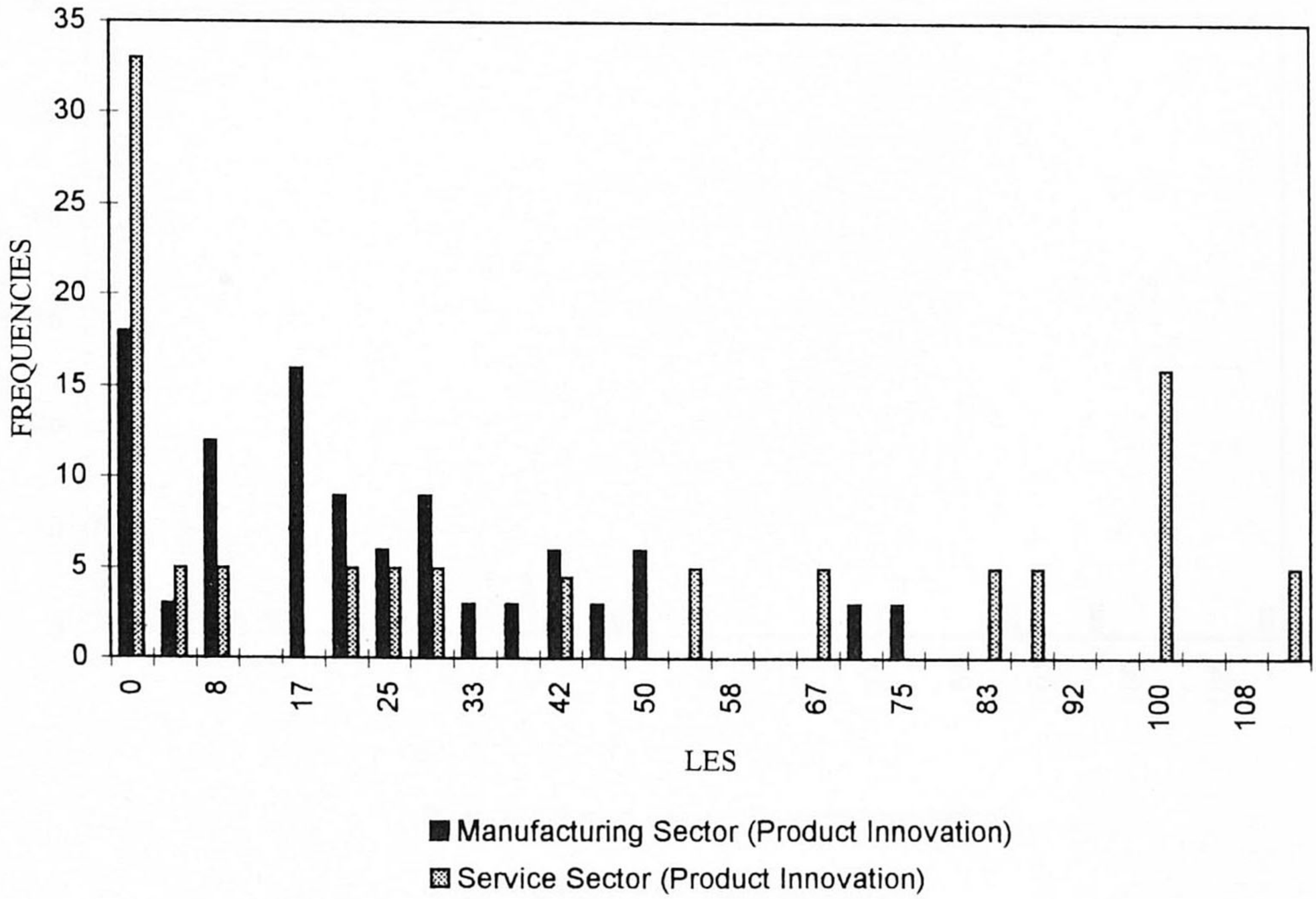

Figure 4 Comprehensive LES scores regarding product innovation.

In a way, both sectors are more or less alike: the lower score values are evidently more pronounced. Remarkable, however, is the high percentage (34%) of the service sector which has a score value of 0 compared to 18% of the manufacturing sector. Besides, the service sector also shows some peaks in the higher score values (83, 88, 100, and even 113), while the highest score value of the manufacturing sector is 75 (scored by only 3% of the companies). The score in the service sector clearly fluctuates more than that in the manufacturing sector.

Process Innovation

Regarding the service sector, next to consultancy concerned with developing products, we may also distinguish consultancy focused on the renewal of existing production processes. Given the way both sectors score regarding product innovation, it may be expected that the service sector serves also higher than the manufacturing sector in terms of process innovation (see Figure 5).

Figure 5 indeed confirms the expectation mentioned above. The big difference between the extremes in the service sector (0 and 113) is remarkable compared to the relatively small difference between the extremes in the manufacturing sector (0 and 50).

According to the product life cycle theory, product innovation may be considered more uncertain than process innovation. It may be expected, then, that both the service

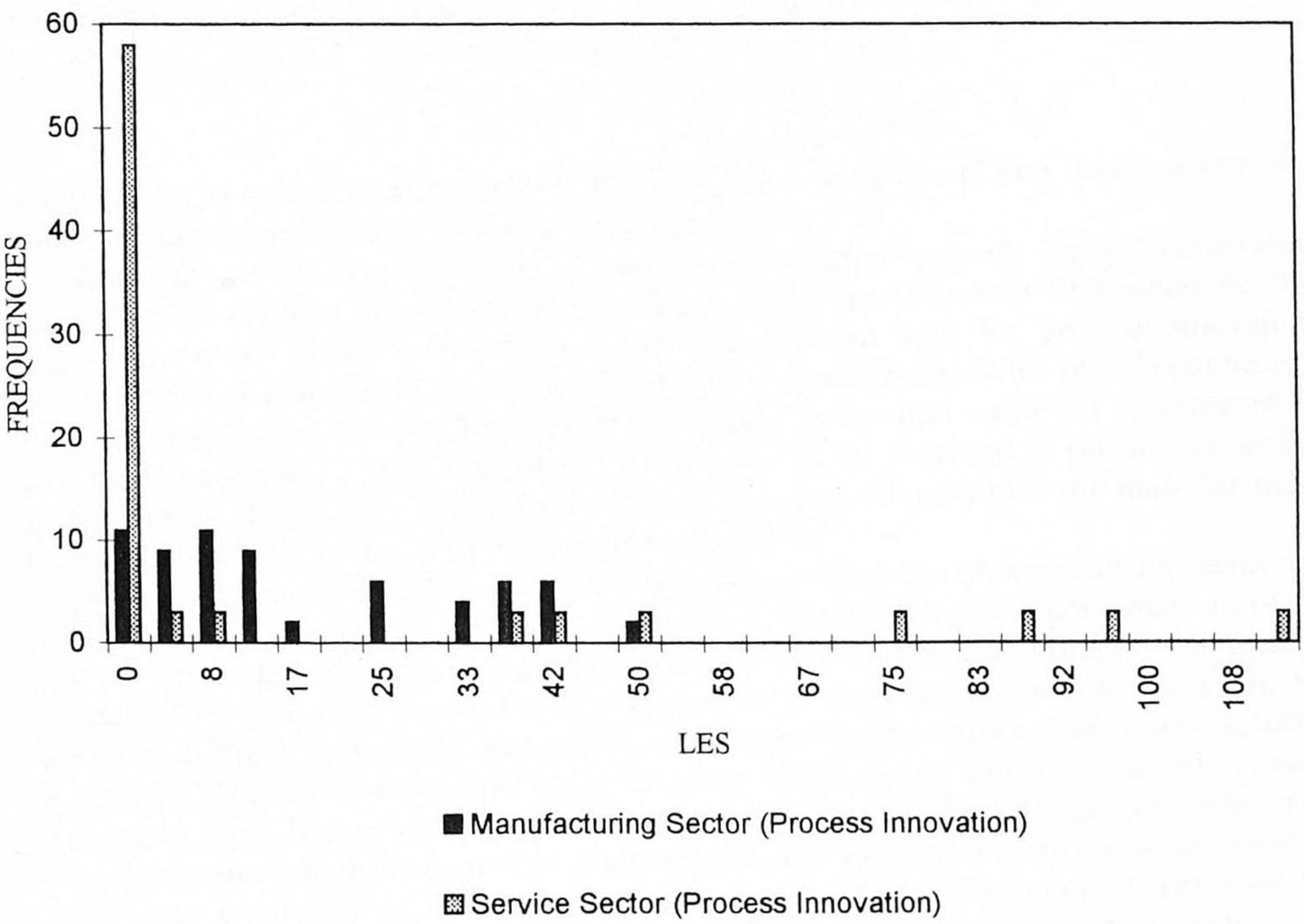

Figure 5 Comprehensive LES scores regarding process innovation.

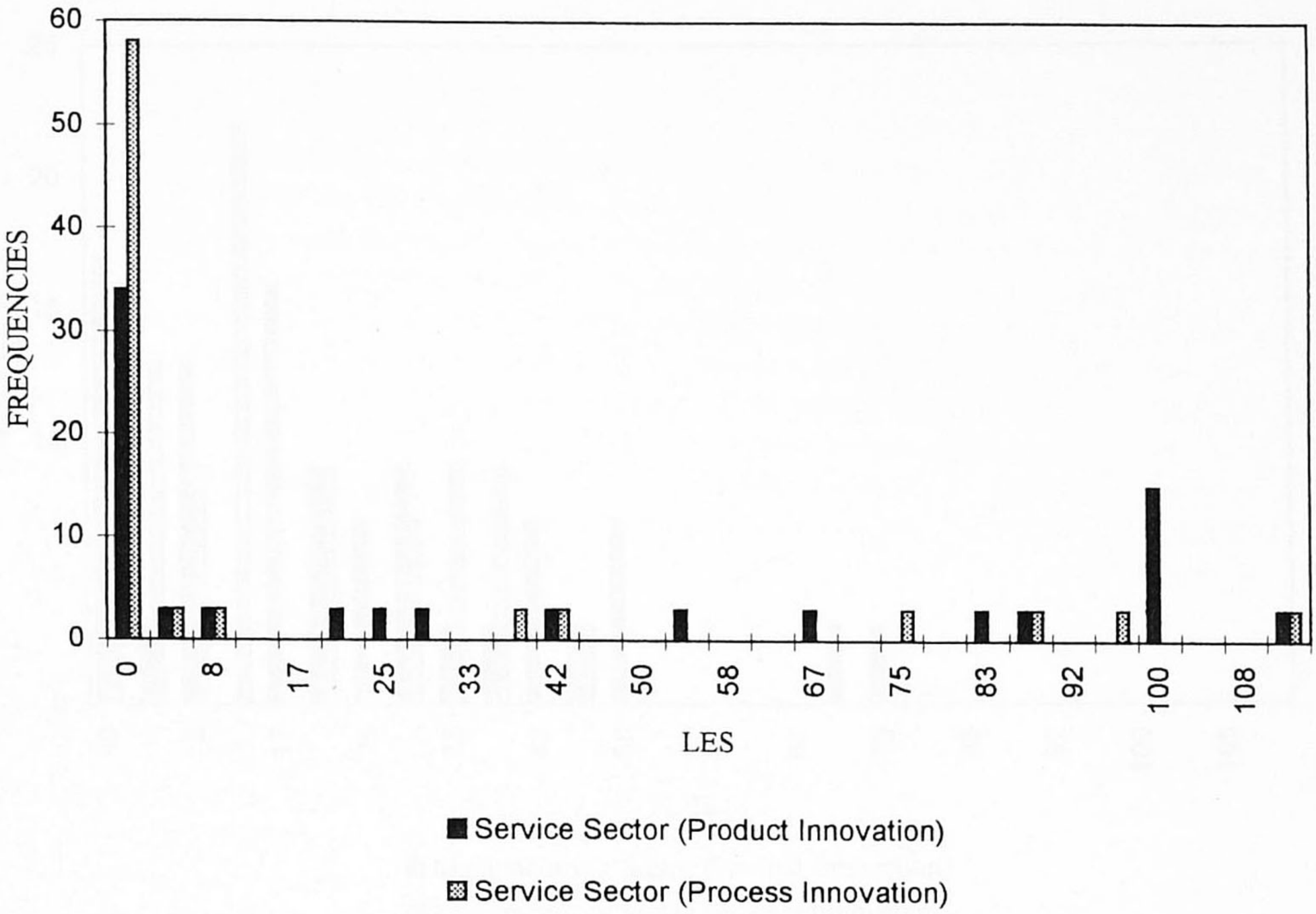

Figure 6 Comprehensive LES scores regarding product and process innovation (service sector).

sector and the manufacturing sector show a higher valuation of the business environment in case of product innovation (see Figures 6 and 7).

Both figures confirm the above expectation and thus represent higher score values in the case of product innovation. For example, in the service sector LES values exceeding 50 are more often observed for product innovation than for process innovation. Furthermore, the distribution of the score values is remarkable: With the exception of a peak for the 0 score value (33% regarding product innovation and even 57% regarding process innovation), a very dispersive distribution can be observed in the service sector. In contrast to this pattern, the distribution of the score values within the manufacturing sector is almost limited to values between 0 and 75.

We may now draw the following conclusions regarding the manufacturing sector and the service sector in the Dutch cities investigated. The results give a confirmation of the product life cycle view, namely, a higher valuation of the local environment of companies in the case of product innovation compared to process innovation. In addition, the results indicate that service companies have higher score values than manufacturing companies. However, within the range of lower score values, the manufacturing sector appears to score higher than the service sector. In other words, although manufacturing companies value their environment relatively less, the value that service companies place upon their environment is either extremely low or is very divergent. Apparently, the service sector is confronted with more uncertainty than the manufacturing sector.

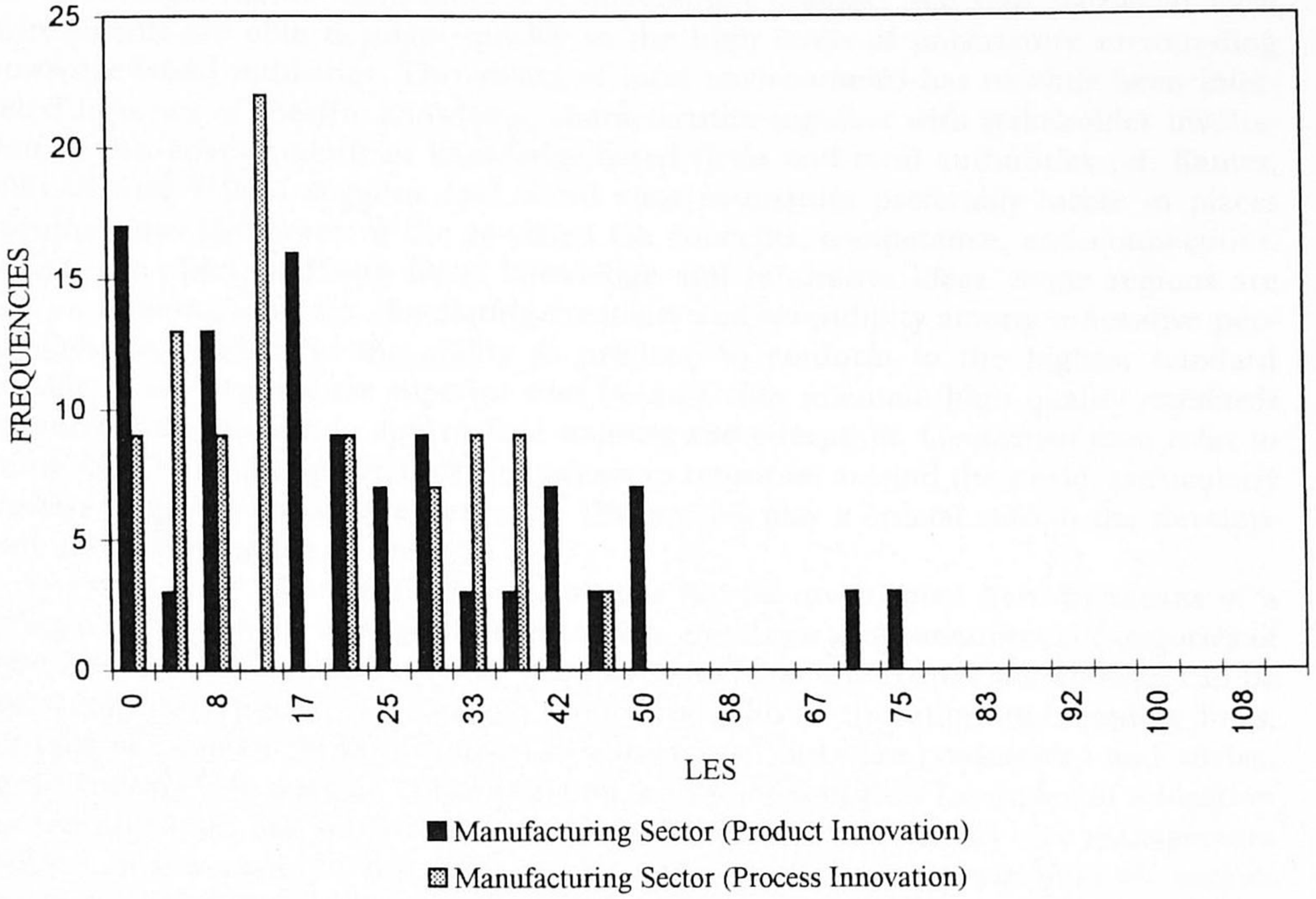

Figure 7 Comprehensive LES scores regarding product and process innovation (manufacturing sector).

USE OF KNOWLEDGE NETWORKS

In light of the data available for European cities, we will now focus more on an international comparison of the impact of knowledge networks, in particular, scientific knowledge networks. Knowledge is created and made available to firms by way of knowledge networks. The term *knowledge networks* is used here to denote a set of nodes together with the links connecting the nodes (Batten et al., 1989). Knowledge nodes typically include stocks of knowledge and infrastructure to create new knowledge and to let knowledge move. Dependent on the level of analysis, nodes refer to individual organizations (such as universities) and to human settlements such as cities and metropolitan regions. The links between nodes facilitate flows of knowledge in different ways, depending upon the type of knowledge, such as embodied and disembodied knowledge.

Knowledge can serve as an intermediate input in production processes as well as a final product in consumer markets. Different from material goods, knowledge can be reused, transformed (or updated), and transferred in almost endless flows. Knowledge can move easily, but particular types of new knowledge (often the ones with a risky and expensive knowledge creation) are prevented from flowing freely with the use of copyrights, trademarks, or patents (protection of property rights).

Aside from this important limitation to the mobility of knowledge, the spread of electronic networks and databases has enormously speeded up the diffusion of knowl-

edge. Thus, the globilization of knowledge networks has caused a leveling of access to new knowledge. At the same time, it is increasingly realized that only particular local environments are able to adapt quickly to the high levels of uncertainty surrounding knowledge-based industries. This ability of local environments has recently been interpreted in terms of specific knowledge characteristics together with stakeholder involvement in this environments of knowledge-based firms and local authorities (cf. Kanter, 1995). Kanter (1995) suggests that world class companies preferably locate in places providing one (or more) of the so-called Cs: concepts, competence, and connections. *Concepts* are concerned with latest knowledge and innovative ideas. Some regions are superior environments for stimulating creativity and serendipity among innovative people. *Competence* refers to the ability to produce to conform to the highest standard available. Some regions are superior sites because they maintain high quality standards and a strong investment in appropriate training and education. *Connections* then refer to maintaining relationships that provide access to resources around the world, particularly gateways to global knowledge networks. Universities play a crucial role in the development and performance of these Cs.

The influence of universities and colleges will be investigated here by means of a qualitative cross-tabular analysis. In this analysis, the three above-mentioned categories of LES values are used. The links of the company with local universities and colleges can be subdivided into three groups, namely, commercial links, education and training links, and staff recruitment links. Examples of commercial links are consultancy and advice, testing and analysis services, subcontracting, and joint ventures. Examples of education and training links are short training courses, training for technical and management qualifications, workshops, and seminars. Examples of staff recruitment links are technically qualified staff and management trainees. Due to lack of data we were unable to investigate all aspects of these three categories, but we have taken some representative relationships from each category. Table 4 shows the frequencies of the types of links with local universities and colleges.

From Table 4 it can be concluded that the majority (51.0%) of the investigated companies make use of training for technical qualifications. With regard to other relationships, essential commercial links are limited to the links consultancy and advice and testing and analysis services. The results regarding almost all educational and training links are interesting, with the exception of workshops and conferences. The use of staff recruitment links is very limited (only about 20% average of the companies investigated maintain this link).

In the remaining part of this section we will now explore whether the *use* of various vehicles of academic knowledge sources influences the perceived importance of the local environment by the firm. Within the group of *education and training links*, short training courses and seminars will be investigated. Companies seeking a production location consider many different attributes. One important consideration may be the presence of local universities and colleges. Especially in the case of education and training, such links play an essential role, because these links may influence the quality of the innovation capacity of a company. It may be expected that companies that contact local universities and colleges in this respect consider their local environment as very important (Table 5). One can interpret the 25.9% in Table 5 to mean that 25.9% (108 is equal to 100%) of all companies using short training courses valued their local environment with a score positioned in the high category, that is, a score value between 75 and 200 for the past (1980s). Compared to companies that do not use this medium, about 29.9% of firms

TABLE 4 • Frequencies of the Types of Links with Local Universities and Colleges

Type of Link	*Absolute Numbers*	*Percentage Share*	*Total Valid Sample Size (Absolute)*
Commercial			
Consultancy and advice	79	32.9	240
Testing and analysis services	74	31.6	234
Subcontracting	32	13.9	231
Joint ventures	21	9.3	227
Education and training			
Short training courses	108	46.0	235
Training for technical qualifications	122	51.0	239
Training for management qualifications	83	36.1	230
Workshops	61	26.4	231
Seminars	71	30.9	230
Conferences	49	21.8	225
Staff Recruitment			
Technically qualified staff	64	27.0	237
Management trainees	32	13.9	231

(Source: Damman, 1994)

valued their local environment highly. The meaning of 68.5% (Table 5) is that 68.5% of all companies using short training courses valued their local environment with a high score for the future (1990s). Compared to the past, more companies (an increase about 43% points) tend to give higher LES values in the future. Thus, among users of short

TABLE 5 • Distribution of the LES with regard to Knowledge Networks (L = Low LES; M = Medium LES; H = High LES)

Type of Link	*Link/No link*	*L (%)*	*M (%)*	*H (%)*	*Total (Absolute)*
Short Training Courses (Past)	Link	12.9	61.0	25.9	108
	No link	31.5	38.6	29.9	127
Short Training Courses (Future)	Link	7.4	24.1	68.5	108
	No link	28.3	33.9	37.8	127
Seminars (Past)	Link	11.3	33.8	54.9	71
	No Link	26.4	38.4	35.2	159
Seminars (Future)	Link	8.5	22.5	69.0	71
	No link	22.6	34.0	43.4	159
Technically Qualified Staff (Past)	Link	6.3	29.7	64.0	64
	No link	28.3	38.2	33.5	173
Technically Qualified Staff (Future)	Link	3.2	23.4	73.4	64
	No link	24.3	32.4	43.3	173
Management Trainees (Past)	Link	3.2	43.7	53.1	32
	No link	25.6	35.2	39.2	199
Management Trainees (Future)	Link	0.0	21.9	78.1	32
	No link	21.6	31.2	47.2	199

training courses there is a surprisingly large shift toward a high appreciation of the local environment in the future.

It seems plausible that seminars are only incidentally related to the activities of companies. Therefore, it may be expected that companies are not as much linked to local universities and colleges as they are to the previous type of education and training mentioned. Especially in the future, the trend regarding the seminars is similar to the one regarding the short training courses. With regard to the future, a high percentage (69.0%) of companies with a university link have a relatively high LES, whereas a relatively low percentage (8.5%) places a low priority on their local environment.

A reason for a shift toward higher score values for the use of both short training courses and seminars may be that companies become more conscious of the significance of the quality of their environment, and hence academic facilities are more highly regarded as important elements of the quality of their business environment.

Within the group *staff recruitment links,* two links, technically qualified staff and management trainees, are considered. Since labor is one of the most essential elements within an organization (Kleinknecht, 1994), it may be expected that companies located in an attractive labor milieu have a high score on these items. Such an interest can be expected for both technically qualified staff and management trainees. However, because management trainees may be much less important to the company than a technically qualified staff, it seems plausible that these links influence the significance of the local environment in a different way compared to technical links (see Table 5 for the results).

In case of links with local universities and colleges, companies value their environment relatively high (for the past: respectively 64.0% and 53.1%; for the future: respectively 73.4% and 78.1%). Thus, it seems that the supply of labor in the vicinity of universities and colleges matches better with the demand for labor than elsewhere, because the willingness of potential employees to move is rather low. Besides, a company aims to keep travel expenses low and thus prefers its employees to live near the company itself. Although it may be expected that management trainees are less a product of the environment than is a technically qualified staff, the results indicate a more or less contrasting result. Probably companies see this item as a more risk-reducing factor.

SUMMARY AND CONCLUSIONS

Three elements have played a central role in our study: (a) the company and its innovative behavior, (b) the local environment of the company, and (c) knowledge networks. These issues have been explored on the basis of a theoretical framework, in which the company is conceived of as an open actor in a dynamic environment. In the theoretical ideas developed in this article, the interactive relationship between the company and its (local) environment has been regarded as strongly influenced by *uncertainty.* Uncertainty is manifested among others in the product life cycle. Different strategies are achieved by a different innovative behavior accompanied by different degrees of uncertainty. In this context, Schumpeter made a useful contribution regarding product innovation and process innovation.

Companies exist in a dynamic world, in which (knowledge) network relationships are increasingly important. Good examples are relationships with suppliers, customers, and knowledge institutes. These relationships contribute to increased effectiveness and innovativeness of companies. Uncertainty in all its forms, may be reduced by means of various elements in the production environment of companies.

Our study is based on an empirical exploration of a large number of companies in different European cities and countries (the sample size was 273). The selected cities host various knowledge institutes, such as a university, higher education institutes, or technical institutes with specific expertise. The analysis has focused on companies in the manufacturing sector. In addition, the service sector was investigated for the Netherlands only.

In a comparison between the manufacturing sector and the service sector in the Netherlands, a comprehensive score representing the significance of the local environment for both product innovation and process innovation has been explored. It appeared that the local production environment in both sectors is essentially more important for product innovation than for process innovation. A further result concerns the different valuations between the two sectors: the manufacturing sector shows relatively low score values and the service sector scores either extremely low or has very divergent values.

The article has also discussed the use of a specific type of knowledge network in European cities, namely, links with local universities and colleges. An investigation of various examples of local knowledge networks has pointed at the following important links: education and training links are more relevant compared to commercial links and staff recruitment links. Especially, "training for technical qualifications" is used by the majority (51%) of the companies. Staff recruitment links are used on average by only 20% of the companies, and the average share that has used commercial links is 22%. Based upon the results, it can be stated that companies that maintain links with local knowledge networks tend to value their local environment higher than companies without those links. This finding provides a convincing argument for the development of a locally based knowledge policy in which companies, universities, and local authorities are principal actors. According to Kanter (1995), in order to advance the development of place-based knowledge resources, companies and universities need to become stakeholders in their places. Local and regional authorities need to support local business and continually benchmark themselves in this respect.

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